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(54)【発明の名称】　ペプチド結晶薄膜材料

(57)【要約】
【課題】　シリコンなどの無機結晶基板上に高度な配列状態を有する生体分子結晶薄膜材料を創製すること。
【解決手段】　無機結晶基板および該基板上に形成された厚さ１～５００ｎｍのペプチド結晶薄膜からなるペプチド結晶薄膜材料。

1

【特許請求の範囲】

【請求項１】無機結晶基板および該基板上に形成された厚さ１～５００ｎｍのペプチド結晶薄膜からなるペプチド結晶薄膜材料。

【請求項２】　無機結晶基板がシリコンである請求項１記載のペプチド結晶薄膜材料。

【請求項３】　ペプチドがジペプチドである請求項１または２記載のペプチド結晶薄膜材料。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、バイオリアクター、バイオセンサーなどのバイオ技術ないし光や光電子分野の半導体技術などに利用することのできるペプチド結晶薄膜材料に関する。

【０００２】

【従来の技術】生体分子固体をバイオリアクター、バイオセンサーなどのバイオ技術ないし光や光電子分野の半導体技術などに利用するばあい、その分子の高度な配列状態すなわち分子結晶薄膜をシリコンなどの無機結晶基板上に形成することが必要である。しかし、これまでそのような生体分子結晶薄膜材料は存在しなかった。

【０００３】

【発明が解決しようとする課題】本発明は、シリコンなどの無機結晶基板上に高度な配列状態を有する生体分子結晶薄膜材料を創製することを目的とする。

【０００４】

【課題を解決するための手段】真空蒸着法を用いることにより、シリコンなどの無機結晶基板上に厚さ１～５００ｎｍのペプチド結晶薄膜を形成することができる。すなわち、本発明は無機結晶基板および該基板上に形成された厚さ１～５００ｎｍのペプチド結晶薄膜からなるペプチド結晶薄膜材料に関する。

【０００５】

【発明の実施の形態】本発明のペプチド結晶薄膜材料は、ペプチド結晶薄膜が無機結晶基板上に形成されたものである。

【０００６】前記ペプチドは２個以上のアミノ酸がペプチド結合により結合した化合物でありアミノ酸残基の数はとくに限られない。ただし、形成されたペプチド薄膜＊の結晶性が良好であるという点でジペプチドが好ましい。

2

【０００７】前記無機結晶基板としてはシリコン、ヒ化ガリウム、ゲルマニウム、炭化ケイ素などの半導体基板があげられるが、半導体の技術分野で広く利用されているという点でシリコンが好ましい。

【０００８】前記ペプチド結晶薄膜の厚さは１～５００ｎｍである。厚さが１ｎｍに満たないばあいは一様な膜形成が困難であり、膜が島状成長してしまい、５００ｎｍより厚いばあいは基板からの電子的影響が与えにくくなる。さらには非光学的目的に限れば、基板と膜との電子的相互作用という点から１～２００ｎｍが好ましい。

【０００９】つぎに前記ペプチド結晶薄膜材料の製法について説明する。

【００１０】真空蒸着法を用いることによりペプチド薄膜を無機結晶基板上に形成することができる。

【００１１】真空蒸着法とは、一般に真空中で金属、非金属などの物質を加熱して蒸発あるいは昇華させ、その蒸気をほかの基体の上に凝縮させて薄膜を形成する方法をいうが、本発明のペプチド結晶薄膜材料をえるためには、以下のような条件で行なう。

【００１２】膜形成下の真空度は10^{-10}～10^{-4}Ｔｏｒｒ、良質な結晶薄膜形成という点で好ましくは10^{-10}～10^{-5}Ｔｏｒｒに設定する。蒸発源を直径０．５～２０ｍｍ程度のノズルを有するるつぼに入れる。基板はホルダーなどに設置する。膜厚計を監視して物質成長速度が０．００１～１ｎｍ／ｓ、結晶性が良好であるという点で好ましくは０．００１～０．３ｎｍ／ｓとなるよう加熱する。基板はとくに加熱しなくてもよい。

【００１３】

【実施例】有機分子蒸発源を直径２ｍｍのノズルを有するタングステンるつぼに入れ、基板をホルダーに設置した。蒸発源の膜厚計を監視して、るつぼを物質成長速度が０．１ｎｍ／ｓとなるように加熱した。形成下の真空度は2×10^{-6}Ｔｏｒｒであった。シリコン基板はとくに加熱しなかった。

【００１４】各分子薄膜に対するエックス線回折強度を表１にまとめた。

【００１５】

（表１）

	厚さ（ｎｍ）	エックス線回折強度（ｃｐｓ）（２θ（度））
ｚ－Ｌｙｓ(ｚ)	５５	０
ｚ－Ａｓｎ	９０	０
Ｇｌｙ－Ｐｒｏ	１５０	１０１８０(１３．５８)
	４０	７００(１３．５８)
Ｂｚ－Ｇｌｙ－Ｇｌｙ－Ｇｌｙ	５５	１００(１５)

表１に示すように、ジペプチド薄膜が最も結晶性がよかった（図１参照）。また赤外線吸収（ＦＴＩＲ）測定からこの膜のペプチド結合の存在を確認した（図２参照）※ので、この膜はジペプチドの分子結晶膜であると考えられる。

【００１６】

3

【発明の効果】真空蒸着法を用いることにより、シリコン結晶基板上に、ペプチドの分子結晶薄膜を形成することができた。このようにしてえられた本発明のペプチド結晶薄膜材料は、この分子結晶をバッファ層として、その上にそのほかの生体分子結晶を成長させることにも利用できる。とくにジペプチド（Ｇｌｙ－Ｐｒｏ）はシリコン基板上に良質の結晶薄膜を形成できる。したがって、エレクトロニクス素子の応用も可能である。

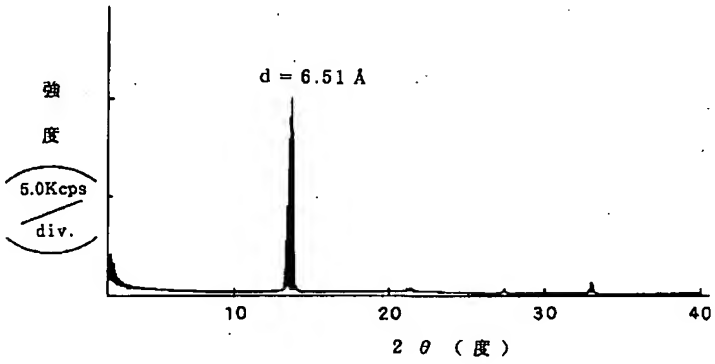
【図面の簡単な説明】

【図１】本発明の一例としてのシリコン基板および該基板上に形成された厚さ１５０ｎｍのジペプチド（Ｇｌｙ－Ｐｒｏ）結晶薄膜からなるペプチド結晶薄膜材料における該ジペプチド結晶薄膜に対するエックス線回折強度を示す図である。

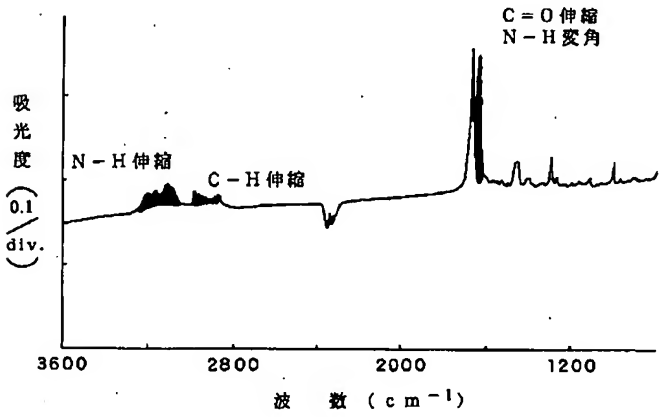
【図２】本発明の一例としてのシリコン基板および該基板上に形成された厚さ１５０ｎｍのジペプチド（Ｇｌｙ－Ｐｒｏ）結晶薄膜からなるペプチド結晶薄膜材料における該ジペプチド結晶薄膜の赤外線吸収スペクトルを示す図である。

4

【図1】



【図2】



CLAIMS

[Claim(s)]
[Claim 1] The peptide crystal thin film material which consists of a peptide crystal thin film with a thickness of 1-500nm formed on the inorganic crystal substrate and this substrate.
[Claim 2] The peptide crystal thin film material according to claim 1 whose inorganic crystal substrate is silicon.
[Claim 3] The peptide crystal thin film material according to claim 1 or 2 whose peptide is a dipeptide.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the peptide crystal thin film material which can be used for the biotechnology of a bioreactor, a biosensor, etc. thru/or light, the semiconductor technology of the photoelectron field, etc.
[0002]
[Description of the Prior Art] When using a biomolecule solid-state for the biotechnology of a bioreactor, a biosensor, etc. thru/or light, the semiconductor technology of the photoelectron field, etc., it is required to form on inorganic crystal substrates, such as silicon, the advanced array condition, i.e., the molecular crystal thin film, of the molecule. However, such [until now] a biomolecule crystal thin film material did not exist.

[0003]
[Problem(s) to be Solved by the Invention] This invention aims at inventing the biomolecule crystal thin film material which has an advanced array condition on inorganic crystal substrates, such as silicon.
[0004]
[Means for Solving the Problem] By using a vacuum deposition method, a peptide crystal thin film with a thickness of 1-500nm can be formed on inorganic crystal substrates, such as silicon. That is, this invention relates to the peptide crystal thin film material which consists of a peptide crystal thin film with a thickness of 1-500nm formed on the inorganic crystal substrate and this substrate.
[0005]
[Embodiment of the Invention] As for the peptide crystal thin film material of this invention, a peptide crystal thin film is formed on an inorganic crystal substrate.
[0006] Said peptide is the compound which two or more amino acid combined by peptide linkage, and especially the number of amino acid residue is not restricted. However, a dipeptide is desirable at the point that the crystallinity of the formed peptide thin film is good.
[0007] Although semi-conductor substrates, such as silicon, gallium arsenide, germanium, and silicon carbide, are raised as said inorganic crystal substrate, silicon is desirable at the point of being widely used by the technical field of a semi-conductor.
[0008] The thickness of said peptide crystal thin film is 1-500nm. When thickness does not fulfill 1nm, uniform film formation is difficult, the film carries out island-shape growth, and when thicker than 500nm, it is hard coming to give the electronic effect from a substrate. If it furthermore restricts to the un-optical purpose, 1-200nm is desirable from the point of the electronic interaction of a substrate and the film.
[0009] The process of said peptide crystal thin film material is explained below.
[0010] A peptide thin film can be formed on an inorganic crystal substrate by using vacuum evaporation technique.
[0011] Although a vacuum deposition method means the approach of heating matter, such as a metal and a nonmetal, making evaporate or sublimate in a vacuum generally, making condense the steam on other bases, and forming a thin film, in order to obtain the peptide crystal thin film material of this invention, it carries out on the following conditions.
[0012] The degree of vacuum under film formation is preferably set as 10-10 - 10-5Torr in respect of 10-10 - 10-4Torr, and good crystal thin film formation. An evaporation source is put into the crucible which has a nozzle with a diameter of about 0.5-20mm. A substrate is installed in an electrode holder etc. A thickness gage is supervised, and it heats so that a matter growth rate may serve as 0.001 - 0.3 nm/s preferably in that 0.001 - 1 nm/s and crystallinity are good. It is not necessary to heat especially a substrate.
[0013]
[Example] The organic molecule evaporation source was put into the tungsten crucible which has a nozzle with a diameter of 2mm, and the substrate was installed in the electrode holder. The thickness gage of an evaporation source was supervised, and the crucible was heated so that a matter growth rate might serve as 0.1 nm/s. The degree of vacuum under formation was 2x10-6Torr. Especially the silicon substrate was not heated.

[0014] The X-ray diffraction reinforcement to each molecule thin film was summarized in Table 1.
[0015]
(Table 1)
Thickness (nm) X-ray diffraction reinforcement (cps) (2theta (degree)) z-Lys (z) 55 0 z-Asn 90 0 Gly-Pro 150 10180 (13.58) 40 700 (13.58) Bz-Gly-Gly-Gly 55 As shown in the 100 (15) table 1, the dipeptide thin film of crystallinity was the best (refer to drawing 1). Moreover, by that (refer to drawing 2) which checked existence of the peptide linkage of this film from infrared absorption (FTIR) measurement, it is thought that this film is molecular crystal film of a dipeptide.
[0016]
[Effect of the Invention] By using vacuum evaporation technique, the molecular crystal thin film of a peptide was able to be formed on the silicon crystal substrate. Thus, the peptide crystal thin film material of obtained this invention can be used also for growing up other biomolecule crystals on it by making this molecular crystal into a buffer layer. Especially a dipeptide (Gly-Pro) can form a good crystal thin film on a silicon substrate. Therefore, application of an electronics component is also possible.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the peptide crystal thin film material which can be used for the biotechnology of a bioreactor, a biosensor, etc. thru/or light, the semiconductor technology of the photoelectron field, etc.

PRIOR ART

[Description of the Prior Art] When using a biomolecule solid-state for the biotechnology of a bioreactor, a biosensor, etc. thru/or light, the semiconductor technology of the photoelectron field, etc., it is required to form on inorganic crystal substrates, such as silicon, the advanced array condition, i.e., the molecular crystal thin film, of the molecule. However, such [until now] a biomolecule crystal thin film material did not exist.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] By using vacuum evaporation technique, the molecular crystal thin film of a peptide was able to be formed on the silicon crystal substrate. Thus, the peptide crystal thin film material of obtained this invention can be used also for growing up other biomolecule crystals on it by making this molecular crystal into a buffer layer. Especially a dipeptide (Gly-Pro) can form a good crystal thin film on a silicon substrate. Therefore, application of an electronics component is also possible.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention aims at inventing the biomolecule crystal thin film material which has an advanced array condition on inorganic crystal substrates, such as silicon.

MEANS

[Means for Solving the Problem] By using a vacuum deposition method, a peptide crystal thin film with a thickness of 1-500nm can be formed on inorganic crystal substrates, such as silicon. That is, this invention relates to the peptide crystal thin film material which consists of a peptide crystal thin film with a thickness of 1-500nm formed on the inorganic crystal substrate and this substrate.
[0005]
[Embodiment of the Invention] As for the peptide crystal thin film material of this invention, a peptide crystal thin film is formed on an inorganic crystal substrate.
[0006] Said peptide is the compound which two or more amino acid combined by peptide linkage, and especially the number of amino acid residue is not restricted. However, a dipeptide is desirable at the point that the crystallinity of the formed peptide thin film is good.
[0007] Although semi-conductor substrates, such as silicon, gallium arsenide, germanium, and silicon carbide, are raised as said inorganic crystal substrate, silicon is desirable at the point of being widely used by the technical field of a semi-conductor.
[0008] The thickness of said peptide crystal thin film is 1-500nm. When thickness does not fulfill 1nm, uniform film formation is difficult, the film carries out island-shape growth, and when thicker than 500nm, it is hard coming to give the electronic effect from a substrate. If it furthermore restricts to the un-optical purpose, 1-200nm is desirable from the point of the electronic interaction of a substrate and the film.
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3.In the drawings, any words are not translated.

EXAMPLE

[Example] The organic molecule evaporation source was put into the tungsten crucible which has a nozzle with a diameter of 2mm, and the substrate was installed in the electrode holder. The thickness gage of an evaporation source was supervised, and the crucible was heated so that a matter growth rate might serve as 0.1 nm/s. The degree of vacuum under formation was 2x10-6Torr. Especially the silicon substrate was not heated.
[0014] The X-ray diffraction reinforcement to each molecule thin film was summarized in Table 1.
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[0016]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the X-ray diffraction reinforcement to this dipeptide crystal thin film in the peptide crystal thin film material which consists of a dipeptide (Gly-Pro) crystal thin film with a thickness of 150nm formed on the silicon substrate as an example of this invention, and this substrate.
[Drawing 2] It is drawing showing the infrared absorption spectrum of this dipeptide crystal thin film in the peptide crystal thin film material which consists of a dipeptide (Gly-Pro) crystal thin film with a thickness of 150nm formed on the silicon substrate as an example of this invention, and this substrate.

* NOTICES *

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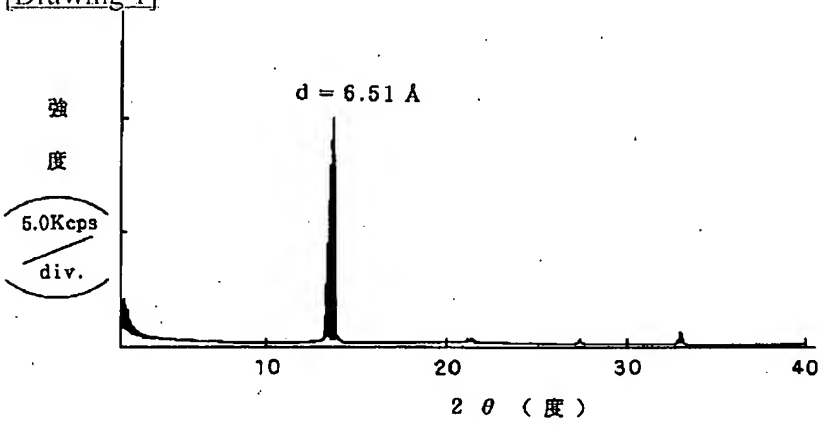
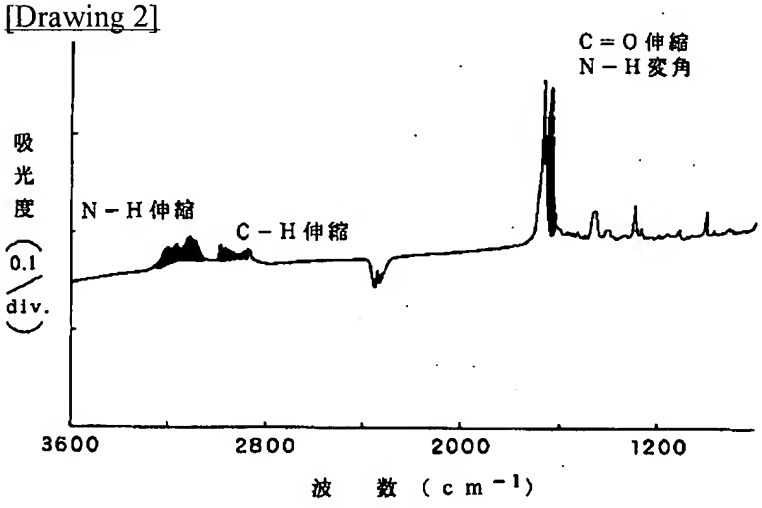
DRAWINGS

[Drawing 1]



[Drawing 2]



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